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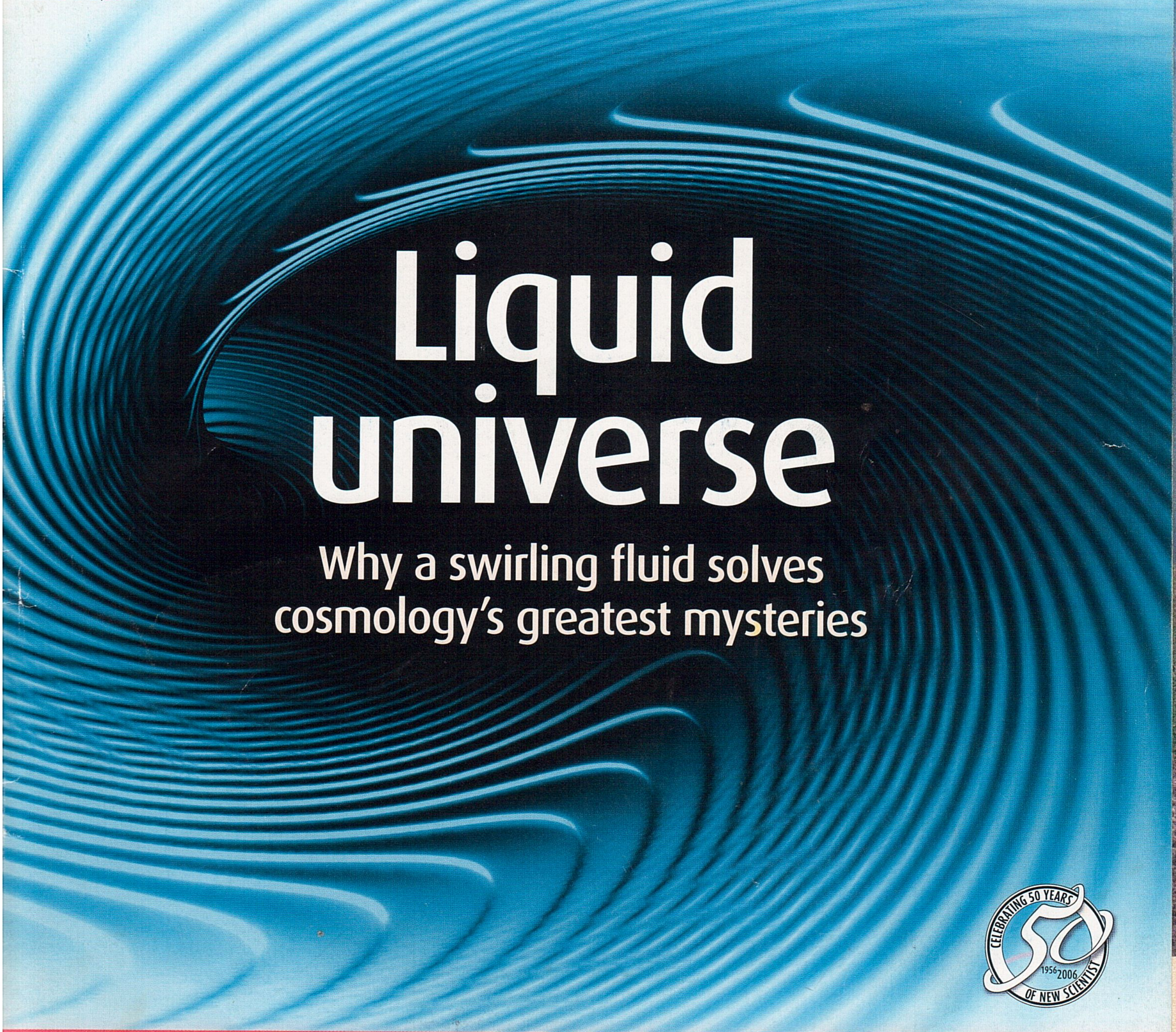

Liquid universe

Why a swirling fluid solves cosmology's greatest mysteries

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No pipes, valves or plumbing, just a bath of oil...

IMAGINE trying to suck molasses through a straw, and you get some idea of the big problem facing microchip-sized "labs" designed to perform experiments on tiny quantities of fluids or biomolecules. Liquids all too easily get stuck in their diminutive pipework and gum up their valves and pumps.

Now a team has developed a lab-on-a-chip that can move reactants around without using pipes. They even have their own equivalent of a Bunsen burner built in to speed reactions along.

Standard lab-on-a-chip devices, which are used for drug discovery or diagnosing disease, work by pumping picolitre volumes of test liquids around microchannels and reaction chambers etched into a silicon or polymer substrate. However, their pumps and valves can jam up, and some fluid always sticks to the channel walls or soaks into them. This can be a big drawback when you need to do lots of tests on a limited volume of fluid, such as a blood sample.

So in 2004, Michael Sailor, a chemist from the University of California, San Diego, and his team published details on a novel way to construct a lab on a chip, eschewing microchannels and valves entirely. They have now revealed their progress and how they introduced heat into their device in the *Journal of the American Chemical Society* (DOI: 10.1021/ja0612854).

In their scheme the chip becomes a miniature oil bath, and the water-soluble reactants are suspended in the oil in 1-millimetre droplets (see Diagram). To move the suspended droplets and react them together, you need a way to grab hold of them, so the team's answer is to add tiny flakes of a mixture of silicon and iron oxide, coated on one side with an oil-loving substance and on the other with a water-loving one. This makes the fragments self-assemble around the outsides of the droplets.

"This lab-on-a-chip can move reactants around without using pipes"

Because iron oxide is magnetic, the team can then use an array of electromagnets in the base of the chip to position the droplets anywhere in the bath, including bringing them together.

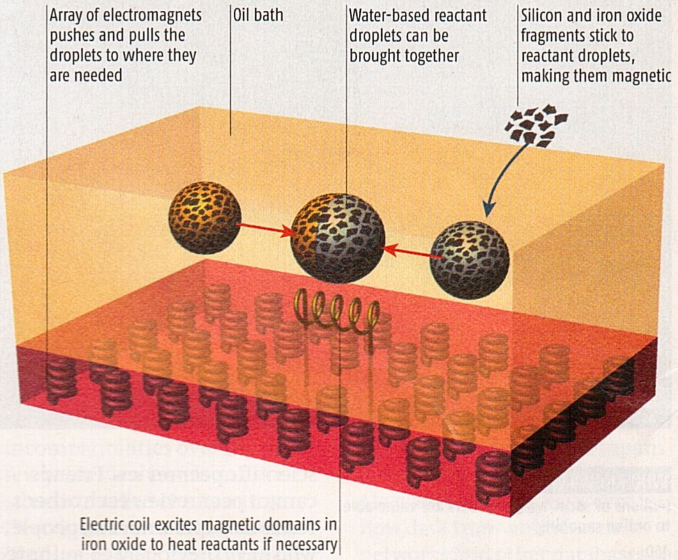
Of course, reactions often need heat to get them going, so Sailor's team plans to place a coil in the centre of the bath to heat the droplets magnetically.

Bench tests of the technology show it is all feasible, says Sailor, although he hasn't yet built a complete chip. For instance, the team showed that a droplet magnetically steered close to a heater coil became hot because some DNA placed inside it unwound – and re-coiled when the heat was removed.

"The thing that's really nice is that it doesn't heat up the surroundings," Sailor says. "This allows us to apply heat in precise regions." **Celeste Biever**, Boston ●

PIPE-FREE MICROLAB

Eliminating pipework by suspending droplets of reactants in oil makes for a blockage-free lab-on-a-chip



Can beer bottle tops help to rescue Africa's soil?

SOMETIMES low tech is much better than no tech. A simple, affordable way to apply crop fertiliser directly to plants looks set to revolutionise the way poor farmers in sub-Saharan Africa grow food. And it all hinges on beer bottle tops.

This week, African heads of state meet in Abuja, Nigeria, for a summit on the continent's deepening soil fertility crisis. Three-quarters of the soil in sub-Saharan Africa is severely depleted of nutrients, because farmers do not use fertiliser or spread manure.

The summit aims to hatch a soil rescue plan, and this is where the beer-bottle tops may well play an unexpected role. They make ideal measuring pots for "micro-dosing", a technique that lets farmers focus precious nutrients where they are needed rather than wasting them. The results so far are encouraging.

Having pinpointed a lack of nitrates as the main factor limiting yields in southern Africa, Steve Twomlow of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), based in Bulawayo, Zimbabwe, established that about 5 grams of ammonium nitrate is enough to feed three plants: that's one beer cap full. Conventional scattering of fertiliser uses five capfuls for every three plants.

For sorghum and pearl millet, Twomlow found that dabbing the fertiliser dose around the base of a plant once it is knee-high boosts yields by between 30 and 50 per cent. "Nearly every treated farm in our trials gave positive yield increases," says Twomlow.

"Tops make ideal pots for measuring out nutrients where they are needed"

In parallel trials in western Africa, where lack of phosphates was the limiting factor, the problem could be corrected by giving each plant a "three-finger pinch" containing 2 grams of diammonium phosphate, plus a gram or so of urea.

Here yields for pearl millet and sorghum rose by up to 120 per cent, boosting farmers' incomes by up to 134 per cent.

For micro-dosing to work, though, ICRISAT is pressing agribusinesses to make fertiliser available in smaller, more affordable packets. This is expected to be another focus of the Abuja summit. Andy Coghlan ●